THE TELEGRAPHIC JOURNAL.
VOL. VI.—NO. 126.

WILLIAM ORTON.

THE HON. WILLIAM ORTON, the President of the Western Union Telegraph Company of North America, died on the 23rd inst. He was a remarkable man. Born in the backwoods, bred in a log hut, educated under the guidance of his stern parents, by his own industry, observation, and self-help, he became a type of the backbone and strength of the United States. Self-reliant, keenly observant, terribly energetic, thoroughly business-like, he speedily worked himself into the front rank, and before he was 40 he became President of the Western Union. For years he ruled that Company with a rod of iron. "L'Etat c'est moi" was true of this Association. He was an autocrat, but a very just one. Though no telegraphist, he made himself perfect master of the details of every branch of the business. There was nothing that escaped his notice. Everyone that served under William Orton felt that he was serving under a master. His power was felt everywhere. The humblest operator in the most distant State felt that he was acting under the eye of his chief. He was a better electrician than the electricians, and he personally undertook the repair of a cable rather than send to England for a skilled engineer. He would spend a whole day in some distant office watching the working of the wires and the behaviour of the apparatus. He would make his own contracts for the purchase of material. Indeed, he probably maintained self-action to too great a state. It is impossible to administer a large concern without a proper distribution of work. William Orton tried to do too much himself. His industry was untiring, and there is no doubt that "work" has killed him. All his friends for some time had urged rest. He had just secured three months' leave of absence but the end came suddenly, and at the ripe age of 52 he suddenly passed away.

Unfortunately, in the United States, jobbery is rampant. It is the exception to find a man in power untainted and unstained. William Orton was the exception. No one could accuse him of being unjust or of being an extortioner. His honor was unstained.

He was a man of an excitable temperament, and he had been for a long time very much worried by the anxieties of a determined competition and by the wild financial operations of an unscrupulous speculating ring. One competition was stayed only to beget another, and nothing could restrain the Wall Street gang. The most serene mind could scarcely withstand the effects of such disturbing influences, a sensitive mind like his would necessarily suffer severely.

The progress of the Western Union Company under his control has been very marked. When he first assumed the presidency it possessed 37,380 miles of line, 75,686 miles of wire, 2,250 stations. It can now boast of 76,955 miles of line, 194,323 miles of wire and 7,500 stations. Its gross revenue was 6,500,000 dollars, and now it is 10,000,000. The capital and debt which was 46,000,000 dollars, is now 40,000,000 dollars. A reduction! The number of messages transmitted by it was 6,404,595, the number is now 21,158,941.

He frequently visited Europe and his face is well known in London. Few who ever knew him will forget him, and especially those who have been admitted into his confidence and his home, who have admired the sterling realities of the man, who have seen the affectionate regard of a husband and a parent, and who have watched the gentle influence of the Christian override the powerful influence of the stern man of business. He will be sincerely regretted by many friends in England.

VARLEY'S ELECTROSTATIC MULTIPLIER.

THIS apparatus consists of a vulcanite disc mounted upon an axis carried upon insulating standards, and capable of being rapidly rotated. On the face of the disc are fixed strips of tinfoil, radially and at distances apart. In front of the disc, and diametrically opposite the one to the other, are two collecting combs by which the electricity passes from the face of the disc to the conductors of the machine. As the disc revolves, the strips of tinfoil pass in succession in proximity to the collecting combs. In close proximity to the disc, but on the other side of it, are two pieces of wood, mounted on insulating standards, and serving as the inductors; they are about the same width, or somewhat wider than the collecting combs, and are of curved form, each inductor covering about a quadrant of the operative part of the disc, or that which passes near the points of the collecting combs, and upon which part on one side of the disc are the strips of tinfoil. The inductors are so fixed upon their insulating supports that the leading end or commencement of the inductor is immediately opposite to the collecting comb, but on the other side of the disc.

For the purpose of charging the inductors there are other combs similar to the collecting combs, and similarly placed, but removed from them by an angular distance of ninety degrees, so that they are opposite to the ends of the inductors, but on the other side of the disc. These combs are placed in

metallic connection with the inductors, each to each. To render the machine self-charging, the last mentioned combs also carry springs or wire brushes, which make metallic contact with studs upon the face of the disc, and in metallic contact with the tinfoil strips upon it, each to each. As soon as the machine is at work, these springs or brushes can be lifted out of contact by means of silken threads, or other convenient attachments.

standards. E, E, are the combs for charging the inductors; they also are insulated, and they are connected by the covered wires E^1, E^1, with the inductors. E^2, E^2, are the springs or wire brushes for making contact with the studs A^2. The contact is made when a finger key (not shown) is depressed. The key acts through silken cords, which draw the brushes or springs forward; when the key is liberated they move back out of contact.

FIG. 1

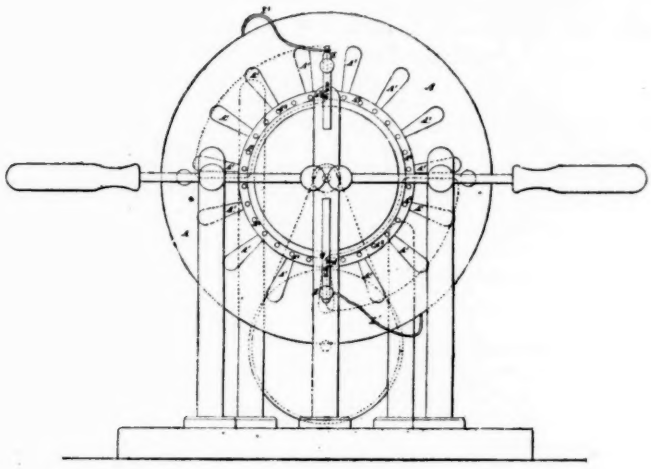


FIG. 2

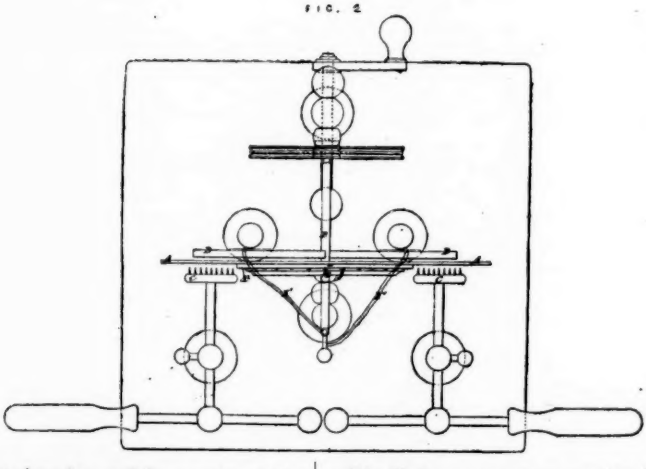


Fig. 1 is a front elevation, and fig. 2 a plan of the electrostatic multiplier. A is the vulcanite disc on an axis B carried by insulating standards. The axis has upon it a pulley which receives a driving cord from a wheel which is rotated by hand; A^1, A^1, are tinfoil strips fixed upon the face of the disc, and A^2, A^2, are studs in metallic connection with the strips A^1; C, C are metallic collecting combs, and D, D, are the inductors; both are carried upon insulating

Mr. Varley proposes to employ his electrostatic multiplier in connection with the electric light, so as to render the latter constant. For this purpose, he places its conductors near the carbon holders, so that a stream of sparks may pass to them constantly so long as the light is being maintained. The high tension electricity, which in this manner is caused to pass between the carbon points, effectually maintains the magneto-electric discharge.

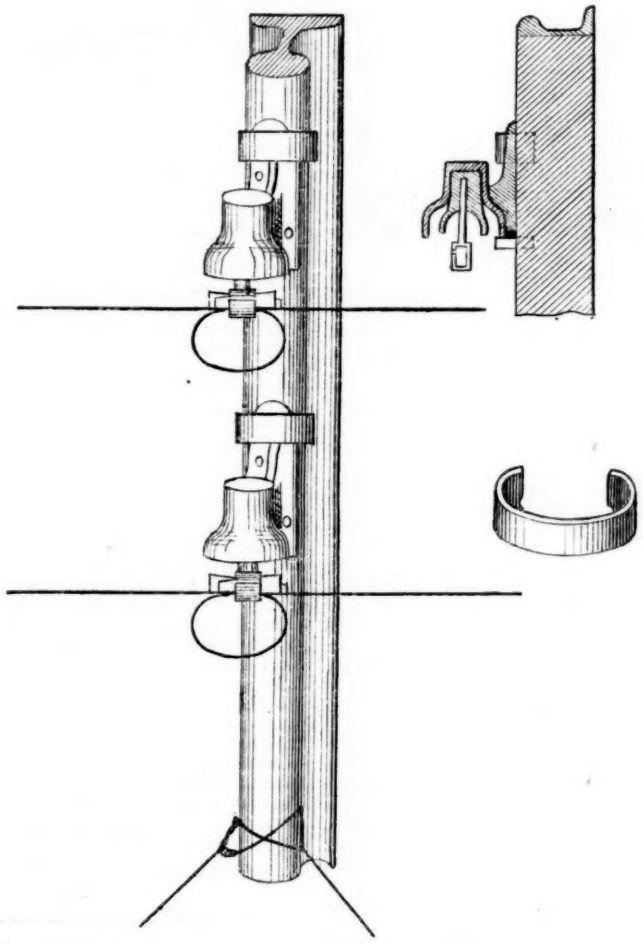
TELEGRAPH CONSTRUCTION IN THE BRAZILS.

By R. G. B. DAVIDS, Telegraph Engineer, Paulista Railway, Associate of the Society of Telegraph Engineers.

IN 1876 I was sent for from the Southern division of the English Postal Telegraph Service to take charge of the telegraph system of the Paulista Railway, Sao Paulo, Brazils. I left England under the impression that Siemens' iron poles were in use on the line, but great was my disappointment when, instead of seeing nice straight lines of iron poles, I found the most miserable erections I had ever seen. The poles were of wood, and of all shapes and sizes, set at various angles in the ground, and so crooked that they might fairly be compared to a cork-screw, whilst the wire, instead of being well stretched, hung in festoons of various dips, and in many places touching the ground.

I at once commenced making notes of pole roofs, stays, earth wires, &c., &c., but found after all that these miserable looking lines were the best that could be made under the circumstances.

Owing to the wood of the country rotting so quickly (in the usual place just below the ground line) it was a useless expense to fit up a pole as in England, for every three years, at the outside, the entire line had to be renewed; in one case the greater portion of the poles on a line of sixty kilometres had to be replaced after having been erected only one year.



This set me devising all sorts of means for the improvement of the line, amongst others, the

splicing of the poles at the foot with sound timber, the bolting of the poles to pieces of rails, &c., but I gave all these ideas up, as the expense would have been greater than the advantage gained, as I found that the poles in a short time tended to decay, generally over the whole length of the line.

As each pole cost three milreis (six shillings) and had to be renewed so often, I came to the conclusion that it would be far cheaper to send home for Siemens' iron poles, and renew the whole line at once, but this the Company did not feel inclined to agree to, owing to the larger prime cost of iron over wooden poles.

I should state that our line of railway consists almost entirely of curves, not curves such as are made on an English railway, but very much sharper, many of only nine hundred feet radius; the opinion of Brazilian engineers being that it is cheaper to make enormous deviations, and run miles away from the direct line, than to make cuttings and embankments. The greater portion of the line also runs through forests, with only a few metres clearance on either side of the track; for this reason, in order to keep the wires clear of the branches of trees and the tropical underwood, as many as from twenty-seven to thirty-two poles per mile have to be employed in some sections. Thus it will be seen that the question of the cost of maintenance of the poles required serious consideration.

The rails employed on the line are of the Vignoles type, twenty-one and twenty-four feet in length; of these there were lying in various localities hundreds, worn out and of no further value, even as old iron, owing to the great cost of transport to England.

Here I fancied there was what I required, but the question was at how little an expense and in what way were these to be employed?

Without a base plate, I at first thought that a rail would not support itself in the ground, especially on the sharp curves and soft banks, but I found upon experiment that this idea was unfounded, as a rail punned into a hole only three feet six inches deep, when blocks and tackle were attached to its top and pulled, bent to an angle of about sixty degrees and then cracked across, just below the ground line, without coming out of the ground.

The insulators employed on the line are Messrs. Siemens' iron hooded inverts, through the hooks of which on five poles the wire passes freely, being stretched and wedged at the sixth. These insulators I proposed bolting on to the rails, but to Mr. W. J. Hammond, the Locomotive Superintendent and General Manager of the line, I am indebted for the idea of the very simple, cheap, and admirable arrangement by which they are now fastened, and which I will endeavour to describe.

The rails are sent into the workshops, where they have two $\frac{3}{4}$ in. holes drilled about $1\frac{1}{4}$ in. deep, on the top face, the first being 12 inches from the top of the rail, and the second 16 inches from the first. Another hole, 1 inch in diameter, is at the same time drilled through the side of the rail, 18 in. below the second hole: this is for the purpose of fastening the stay wire, and is drilled 18 inches below in order that room may be left for the fixing of a third insulator, should such at any time be necessary.

Into the holes on the face of the rail are driven pegs, cut from $\frac{3}{4}$ in. bar iron, these pegs are allowed to project about $\frac{1}{2}$ in. Upon them the insulators are set, and are fixed in position by means of an iron hand formed to clip the sides of the rail and driven over the plate of the insulator. I give a rough sketch of a rail with the insulators attached, which will perhaps make my description more clear.

The pegs and insulators are fixed on the line before the rail is erected, the bottom band being slipped on before the top peg is driven in, otherwise it would not pass it.

The rails are put six feet into the ground, and well punned, being lifted into their position by means of shear legs and blocks.

The holes are made by two tools, called respectively the "cavadeira" and the "enchada." The cavadeira is exactly similar to a very large flat carpenter's chisel, 8 in. long by $3\frac{1}{2}$ in. across, fixed to a long handle; it is employed to break the earth. The enchada, a tool very similar to a Spanish spoon, is employed for clearing out the earth broken by the cavadeira. Marshall's earth borers would be far preferable to these tools, and I intend giving them a trial. When they arrive I expect to do the work of making the holes twice as fast as at present.

The stretching poles are stayed on either side, in the line of the wires, to prevent their being pulled over, in case both wires are broken at once by the falling of trees, &c.

When stretching the wires, the stay which supports the strain is only temporarily punned. When the wires are pulled up at the next straining pole the stay at the last is left very slack, the stay-block has, therefore, to be sunk deeper.

For stay wires I employ strand signal wire, and for stay blocks, old fire bars rejected from the engines, short pieces of rail, or, in fact, any old scrap iron.

The rails, when erected, are tarred all over, and as coal tar in this country dries like black varnish, it gives them a very good appearance.

As we are now passing through the rainy season they are having a rather severe trial, but I am happy to say there is not the least appearance of any one rail having sunk, or gone over, in the slightest degree.

The railway company, with which this line is in connection, being about to employ their old rails in a similar manner, I am induced to send this short description in the hope that it may prove of value to others who may be placed in a similar position to that in which I found myself.

MILLIWEBER, OR MICROWEBER?

By M. ROTHEN, Assistant Director of Swiss Telegraphs.

THE number of the *Journal Télégraphique* of 25th February, reproduced a proposal recently made by Mr. Preece before the Society of Telegraph Engineers of London for the adoption, for purposes of practical telegraphy, of the milliweber as the unit of electric current. In support of this proposal, Mr. Preece observed that the introduction of the milliweber would enable us to express by very simple figures the currents habitually employed on telegraph lines.

In my opinion this would be the only advantage of the proposed unit, an advantage of too small importance to compensate the serious inconveniences which its adoption would present from other points of view. With the *volt*, the *weber*, the *ohm*, and the *farad*, we possess a complete system of absolute electrical units, based on the centimetre-gramme-second. We are, furthermore, accustomed to regard as derived units the multiples which represent a million of the fundamental units, and the submultiples which represent the one-millionth part of such units; and we designate these derived units by the special denominations formed by prefixing "mega-" or "micro-" to the name of the fundamental unit. Either the fundamental unit, or one or other of its derivatives is used, according to which is best adapted to the electrical magnitudes dealt with in telegraphy. Thus the *volt* is almost exclusively used to express differences of potential, the *megavolt* being so large and the *microvolt* so small that it is very rarely these derived units can be made to represent differences of potential in simple figures. The *megohm*, on the contrary, is almost as often employed as the *ohm*, all resistances of dielectrics being much more simple in *megohms* than in *ohms*, while the *microhm* has only a theoretical value. The reverse occurs with the *farad*, where the fundamental unit is so large a quantity that the *microfarad* is the only one of its derivatives which corresponds to the quantities used in telegraphy. The whole capacity of a transatlantic cable, for instance, does not exceed 800 *microfarads*, or 0·0008 *farad*.

Nothing is more rational and logical than to choose as multiple and submultiple of the *weber*, the *megaweber* and the *microweber*. Why abandon here the system followed with derivatives of the other units, and upset the harmony which exists in the conception of absolute units? To simplify figures, says Mr. Preece; but is this advantage of such value that we should sacrifice to it uniformity in the constitution of derived units! I think not. Let us say, for example, 14 milliwebers instead of 14,000 microwebers: neither the idea nor the comprehension of the magnitude is clearer. The ohm furnishes us with a striking example. Such expressions as 1,000, 8,000, 15,000, 50,000 ohms are perfectly familiar to us, because they present themselves daily, so to speak, when we are dealing with resistances of telegraph lines or of rheostats. True, it must be admitted that the ohm is a rather small unit for our ordinary resistances, and that, for simplicity of expression, it would be preferable if it had a tenfold or hundredfold value, but it is unhesitatingly employed nevertheless.

The microweber is also, I do not deny, a rather small unit, and most frequently one is obliged to express magnitudes in thousands of microwebers. But this slight inconvenience, which we have just shown attaches to the ohm, does not appear to us a sufficient reason for the substitution of that exceptional derivative, the milliweber. Furthermore, there are numerous instances in which the microweber offers a standard value more appropriate than the milliweber. Such are, for example the cases of the currents of some derived circuits, of those which flow in telephonic circuits, through substances of low conductivity or delicate galvanometers such as the mirror galvanometer of Sir W. Thomson. In several of these cases, which are not purely theoretical but occur in practical telegraphy, the values should even be expressed in fractions of the microweber.

It would then, it appears, be inconsistent to choose, as proposed by Mr. Preece, the milliweber in place of the microweber, and I think, with Mr. Latimer Clark, that electricians will hardly decide upon the adoption of this new submultiple.

Finding myself in disagreement with Mr. Preece on this point I the more willingly agree with his other wish that the telegraphic world should make more frequent use of the weber than has hitherto been the case. It is, in fact, very desirable that the strength of currents should be always expressed in webers. This is the only means of obtaining precise expressions. As it is we do not even know the strength of current used by neighbouring adminstrations because a common unit is wanting, or rather because this common unit is not made use of.

Mr. Preece informs us that the mean current used in England on Morse circuits is 5,000 microwebers. This led me to determine the average of the currents used in Switzerland. To regulate the strength on Morse circuits, the administration makes use of a simple method, but one not presenting any very great exactitude. The strength of the current is indicated by the deviation of the needle of a special detector, the helix of which has 32 turns; and deflections of 30° and 36° are allowed as the minimum and maximum of current strength. This limit is large; perhaps, as we shall see, too large for good working.

Although all the detectors (boussoles) are constructed according to the same type, it will not appear astonishing that the indications for the same current vary sensibly for different detectors, and even, with the same detector they vary accordingly as the deviation is to the right or to the left. It may be said that there are no two detectors which under the same conditions give identically the same deviation; in certain cases the difference may be as much as 20 per cent., so that their indications cannot be trusted for equalising currents. To obtain, therefore, means which should be to some extent comparable, I was obliged to determine the value of the deviations of a large number of the detectors, by calculating for each of them, and in both positions of the needle, right and left, the necessary strengths in microwebers to express the maximum and minimum of the deviations allowed. I have thus obtained results which represent sufficiently exactly the two limits of the effective currents on Swiss telegraph lines.

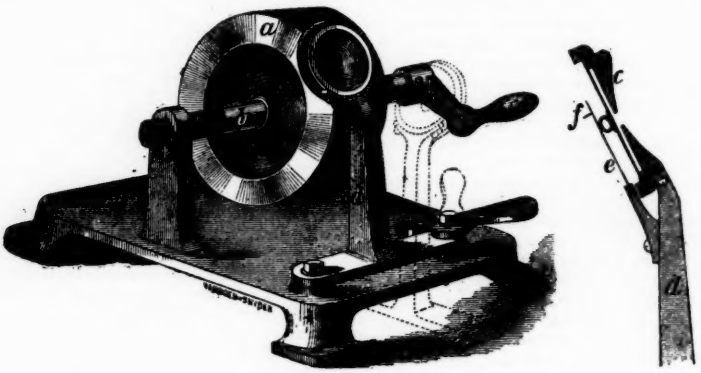
The electric currents circulating in Switzerland on telegraph lines with Morse receivers, must have a minimum strength of 8,900 and a maximum of 13,500 microwebers.

It is seen from these figures not only that the currents used in Switzerland are sensibly stronger than those in England (being double and even triple), but that the variation allowed is very wide.

It would undoubtedly be very useful and instructive to know similarly for other administrations the mean strengths of the currents employed, and that not only for Morse circuits but also for the other telegraphic systems in use.—*Journal Télégraphique.*

EDISON'S PHONOGRAPH.

FIGS. 1 and 2, for which we are indebted to the *Journal of the Franklin Institute*, Philadelphia, show the phonograph as at present constructed. Fig. 1 gives a general view of the instrument. Fig. 2 shows the diaphragm and stylus. The former is formed of a ferrotype plate, such as is employed in the ordinary telephone. The stylus is fixed to the end of a piece of watch spring, which presess against a small piece of india-rubber tubing fixed to the centre of the diaphragm. The piece of rubber acts as a cushion, and greatly improves the action of the apparatus, as it is found that if the stylus is attached directly to the diaphragm the action is not satisfactory. The diaphragm answers both for recording the impressions on the foil (lead) on the drum, and for reproducing the sounds, when the handle is turned. The diaphragm is mounted in a metal frame, attached to a moveable lever, which enables the point of the stylus to be withdrawn from the surface of the foil when the drum is to be screwed back to its starting position, after the impressions have been recorded. The dotted lines in fig. 1 show the position taken up by the frame and lever when the latter is turned back.



IT is announced from Berlin that England wishes to put off the Telegraph Congress till the 1st of June, 1879, in order to have ample time for testing the pecuniary results of the word tariff now existing between England and Germany, before discussing its extension to other countries and quarters of the globe.

THE SOCIETY OF ARTS.

TECHNOLOGICAL EXAMINATIONS.

THE Council have determined to add Telegraphy to the list of subjects in the Society's Technological Examinations.

The first examination will be held during the present month.

The syllabus for the use of candidates has been prepared as follows :—

TELEGRAPHY.

Examiner—William Henry Preece, Esq., C.E.

Part I.—General Science.

1. THE ELEMENTARY CERTIFICATE.—For this Certificate the candidate will be required to have passed in the elementary stage of

Subject 4. Pure Mathematics.
„ 9. Electricity and Magnetism.

2. THE ADVANCED CERTIFICATE.—For this Certificate the candidate will be required to have passed in the advanced stage of the above, and in the elementary stage of

Subject 10. Inorganic Chemistry.
„ 8. Acoustics, Light, and Heat.

3. HONOURS.—For Honours, the candidate must have passed in the advanced stage in the above subjects, and in either of the following subjects :—

Subject 6. Theoretical Mechanics.
„ 7. Applied Mechanics.

Part II.—Technology.

1. The construction, character, and difference of the various batteries employed in telegraphy.

2. The measurement of electrical quantities, and the character of different instruments of precision used in measuring and testing.

3. The character and quality of the different timbers and poles used in the construction of lines of telegraph.

4. Their decay and modes of preservation.

5. The manufacture, difference, and character of iron and copper wire.

6. The manufacture, character, and value of the different insulating materials used in protecting wire for submarine and subterranean purposes.

7. The principles, construction, and action of the different forms of apparatus in use in England in conducting the art of telegraphy.

8. The various natural disturbances that occur during different seasons of the year in impeding or destroying telegraphic communication, and the methods of protection adopted.

9. The causes that retard the rate of working on long land or submarine lines.

10. The various systems in use to increase the capacity of wires for the conveyance of messages.

11. The construction of aerial lines of telegraphs.

12. The principles and practice of jointing.

13. The construction of submarine cables; their laying and repair.

14. The various modes of joining up circuits.

15. The mechanical testing of the various materials used in telegraphy.

16. Faults; their nature, prevention, and localisation.

17. The applications of electricity to railway working.

Reviews.

Journals of the Society of Telegraph Engineers. Nos. XIX and XX. Vol. VI. E. and F. N. Spon, London and New York.

THESE two numbers decidedly show that the reputation of the journal is not likely to suffer; they give full accounts of the proceedings of the Society from April 25th to December 12th, 1877. No. XIX contains papers with discussions on "Batteries," by Martin F. Roberts, F.C.S.; "Double Current Translation," by Gustav Risch; "Description of a New Form of Electric Light (the Jablochkoff)," by W. Langdon, the late acting secretary of the society. Under the head of "Original Communications" we find "Abstracts and Information regarding Soundings taken with Sir William Thomson's Apparatus on the West Coast of South America," by H. Benest; "Description of Combined Key and Switch," by Andrew Jamieson; "Arrangement of Connections necessary for Employment with Sir William Thomson's Recorder or Speaking Galvanometer;" "Unifilar Suspension," by W. E. Ayrton and John Perry; "The Principles to be observed in the Erection of Wires over Long Spans," with tables, by R. S. Brough; "Improved Make and Break Arrangements for Sir William Thomson's Recorder Mill," by James Graves; "The General Theory of Duplex Telegraphy," by Louis Schwendler; "A Case of Lightning; with an Evolution of the Potential and Gravity of the Discharge in Absolute Measure," by R. S. Brough.

In No. XX we have papers and discussions on "Researches in Electric Telephony," by Professor A. Graham Bell; "Selenium, its Electrical qualities, and the Effect of Light thereon," by Willoughby Smith; "The Measurement of Currents," by W. H. Preece; "Earth Currents on Land Lines," and "Sonorous Properties of Electrostatic Induction," by A. J. S. Adams. We next find obituary notices of Major-General D. G. Robinson and of Ruhmkorff. Under the head of "Original Communications and Extracts," we have "Researches on Selenium," by Dr. Engen Obach; "A New and Practical Application of the Telephone," by Elisha Gray; "Earth Currents," by S. M. Barker; "Employment of old Railway Metals for Telegraph Poles," by R. G. B. Davids; "A New Wire Finder," by John Gott; "The General Theory of Duplex Telegraphy," by Louis Schwendler; "The Kaffir War and the Telegraph." An interesting letter from W. F. Channing on the Telephone completes the volume.

Notes.

WE understand that the Society of Telegraph Engineers is about to publish a complete catalogue of the electrical literature collected by the late Sir Francis Ronalds, F.R.S. The entries will be over 12,000 in number, and will include a record of the electrical papers contributed to the proceedings and transactions of the English and Foreign Scientific and Literary Societies. This catalogue, which has been edited by Mr. Alfred J. Frost, the acting-librarian of the society, is the result of many years of careful and patient labour, and, besides being a record of every publication relating to electricity and its application, will also serve as the catalogue of the valuable library formed by Sir Francis Ronalds, now in the possession of the society. We have seen a proof sheet of this catalogue, and we consider from the manner in which it is being produced that it reflects great credit upon the society, and especially upon its editor, and it cannot fail when published, to be a most valuable bibliography of the subject to which it refers.

TELEPHONIANA.—Since the time of Galvani the nervous fibre has been regarded as the most exquisitely sensitive galvanoscope. But the experiments of M. D'Arsonval prove that even an illmade telephone is at least a hundred times more sensitive than the nerve to feeble variations of the current. M. D'Arsonval prepared a frog's leg after the manner of Galvani, and excited the sciatic nerve by the secondary coil of a Siemens and Halske induction *appareil à chariot*, commonly used in physiological researches. After withdrawing the secondary bobbin from the primary until the nerve was insensible to the current, the telephone was substituted for the nerve, and forcible sounds were at once heard. In the silence of night M. D'Arsonval was able to hear the telephone when the secondary bobbin was withdrawn to fifteen times the distance at which the nerve ceased to be affected. Assuming that the intensity of induction decreases by the law of inverse squares, the currents indicated by the telephone were, therefore, at least 200 times weaker than those to which the nerve responded. M. D'Arsonval points out that these feeble induction currents are useful to adjust the telephone by. The telephone is likely to become useful in detecting nervous and muscular currents in

preference to the galvanometer and the Du Bois Raymond Coil, because the latter apparatus by the inertia of the needle is unfitted to indicate rapidly varying currents.

As another instance of the delicacy of the telephone Professor George Forbes of the Andersonian University, Glasgow, finds that when the hot point of a copper wire is drawn along the rasp of a file, the intermittent thermo-electric currents generated causes the telephone to emit a note.

IT is reported that Professor Righi of Bologna has exhibited before the Academy of Sciences, Bologna, a telephone which speaks in loud tones.

THE telephone has been adapted on the coast cable system, employed to facilitate the Norwegian herring fishery.

PROFESSOR LUVINI, of the Military Academy, Turin, finds that the telephone sounds are increased by inserting two electro-magnets, wound with a great many turns of thick wire in circuit, one close to each telephone. A greater number of electro-magnets in circuit does not increase the effect.

TELEPHONIC BOMBAST.—"The diaphragm of the telephone, the thin iron plate, is as sensitive as the living tympanum to all the delicate refinements of sound. Nor does it depend upon the thinness of the metallic sheet, for a piece of thick boiler-plate will take up and transmit the motions of the air-particles in all the grades of their subtilty. And not only will it do the same thing as the tympanum, but it will do vastly more: the gross dead metal proves, in fact, to be a hundred times more alive than the living mechanism of speech and audition. This is no exaggeration. In quickness, in accuracy, and even in grasp, there is perfection of sensitive capacity in the metal, with which the organic instrument cannot compare. We speak of the proverbial "quickness of thought" but the telephone thinks quicker than the nervous mechanism. Let a word be pronounced for a person to repeat, and the telephone will hear and speak it a hundred miles away in a tenth part of the time that the listener would need to utter it. Give a man a series of half-a-dozen notes to repeat, and he cannot do it accurately to save his life; but the iron plate takes them up, transmits them to another plate hundreds of miles off, which sings them forth instantaneously with absolute precision. The human machine can hear, and reproduce, in its way, only a single series of notes, while the iron ear of the telephone will take up whole chords and strains of music, and, sending them by lightning through the wires, its iron tongue will emit them in perfect relations of harmony."— Professor Youmans in the *American Popular Science Monthly*.

THE London Stereoscopic Company have become sole licensees of Edison's phonograph in this country. they have, it is stated, paid for their right the sum of £3000, besides half the profits accruing from their use of it.

AT the Crystal Palace on Good Friday the phonograph made its *début* before a miscellaneous audience. The instrument exhibited was made by Mr. Stroh, the well-known mechanician. The cylinder is driven by regulated clockwork instead of by hand, and the heavy fly-wheel necessary to give uniform motion in turning by hand is therefore discarded. A considerable number of people, including members of the newspaper press, assembled in the Opera House to hear the wonderful "talking machine"—as it is not very happily named. Mr. J. P. Edwards, of the Postal Telegraph Service, courteously undertook to explain the action of the instrument, and to superintend the giving of a variety of instructive illustrations of its powers. Instrumental music, songs, duets (recorded by means of a double mouth-piece), talking, and many other sounds, both odd and common, were faithfully rendered to the amusement and surprise of the audience. We understand that the Stereoscopic Company intend to continue the public exhibition of the phonograph at the Palace, and elsewhere throughout the country. Phonographs can be obtained from them at prices ranging from five to thirty guineas.

EDISON'S Patent, No. 2927, dated July 31, 1877, of which we give an abstract in the present number, serves to illustrate how an invention is generally evolved. In this patent, Edison describes a means of recording ordinary Morse signals by the indentations of a style on a sheet of paper enveloping a cylinder or plate with a V shaped spiral groove cut in its surface. The indented record so obtained was afterwards to be utilised, if required, in sending the same message automatically by means of the indentations. In this contrivance we have, to all appearance, the groundwork of the phonograph. The inventor's mind was prepared by it to receive the suggestion, which would germinate into a recorder and reproducer of actual sounds. This priceless seed is said to have been sown by accidents. While experimenting one day with a telephone, a style attached to the diaphragm, when it was vibrating under the voice, pierced Edison's finger and drew blood. We suppose the idea of the phonograph at once flashed upon him, for he saw that there was force enough in the style to record speech by indentations on a yielding substance, as in his preconceived telegraph apparatus. If this interpretation be correct, we may also draw the moral from it that no original idea is utterly worthless, and no good work is ever thrown away: for, at least, it may in time become the root of something better. Edison's indenting telegraph may never be practically applied, but it has borne wonderful fruit in the phonograph.

IT is stated that the Edison Phonograph was suggested in 1865 by an Italian mechanic of the Val d'Aostò (Signor Manzetti), and published in the *Diritto* of Rome for July 10, 1865, and in the *Petit Journal* of Paris, for November 22, 1865.

EDISON AND THE COCKROACHES.—The Boston office was overrun with cockroaches, and Tom was much annoyed by them. With ready ingenuity he conceived and carried out a plan for their extermination. He tacked several zinc strips to the wall, at intervals of an eighth of an inch. He then applied the positive and negative poles of a battery alternately to the strips. He next smeared the wall above the strip with molasses. The roaches came up in platoons, very much after the manner of the British troops at Breed's Hill. As they stepped from strip to strip they "closed the circuit," received the full benefit of the electric shock, and dropped dead by scores. Tom used to catch their bodies in a water pail, and it is said that the bucket has been filled in a single night.—*New York Sun.*

IT is announced that Major Bateman-Champain has been appointed Director General of Telegraphs in India.

THE Brazilian Submarine Telegraph Company notify that the Lisbon and Maderia cable is interrupted, but as the fault is reported to be near the mouth of the Tagus, it is not anticipated that it will be of long duration. Until communication is restored, messages will be forwarded by post from Lisbon.

AGENTS from the British Government have arrived at Athens to make preparations for laying a special cable to connect the Sea of Marmora with Greece.

THE TELEGRAPH BILL.—This Bill, which was introduced into the House of Lords by the Lord Chancellor, is now issued. The definition "telegraph" is by it extended beyond the limits assigned in the Act of 1869, so as to include any apparatus for transmitting messages, or other communications, by means of electricity. Upon any difference arising between the Postmaster-General and persons or bodies having power to give or withold consent to the Postmaster-General placing telegraphs or posts in, under, over, or across a street, public road, estuary, railway, canal, &c., such difference as to consent shall be referred to arbitration. Power is taken by the present bill for the Postmaster-General to establish telegraphic lines on railways, tramways, roads, and similar undertakings authorised by special Act of Parliament after the commencement of the present year, subject to certain restrictions as to indemnifications to the owners for damage done, and prevention of obstruction, and a long series of provisions is made as to the course to be adopted in the case of interference with, or alteration of, telegraphic lines in the construction of works authorised by Act of Parliament.

AT a meeting of the City Commissioners of Sewers, in the Guildhall, on Tuesday, April 16th, Mr. Deputy White asked the Chairman of the Streets Committee what progress had been made with regard to the electric light. Mr. Bassingham said that the Committee had written to various Continental towns on the subject, and that answers from several of these had been received. He also mentioned that Mr. Boor was about to introduce a lamp, made by a Paris firm, which would be brought before the committee as early as convenient.

THERE are now nearly 10,000 miles of overland lines in operation in Australia.

ON Saturday, March 20th, after two days of hot oppressive weather, accompanied by magnetic storms, a sharp earthquake, was felt in Turkey. The shock to Admiral Hornby's flag ship was so great as to cause the alarm of a torpedo attack.

IT is intended to introduce into the naval service a new "torpedo battery gun," to be used in defending ships against the approach of torpedo boats.

M. MONGENOT has called the attention of the French Academy to a new telegraph of his invention, in which both the transmitter and receiver consist of two ivory plates carrying the disconnected ends of an open part of the circuit. The sender places this contrivance between his lips, and sends the message by talking or by closing the circuit by his lips, according to a code of signals. The receiver, holding the receiving apparatus similarly, interprets the message by the sensation he feels. This is an old idea, but may be cleverly worked out in this case. M. Mongenot claims to become a competitor for the Volta prize with it.

DIMINUTION OF MAGNETISM UNDER HEATING.—According to recent experiments of M. Gaugain, the decrease of magnetism in a magnet heated to a temperature of 300° or 400° C., is due not only to an enfeebling of the existing magnetism, but also to the development of opposite magnetism in the bar.

A NEW MANGANESE ELEMENT.—M. A. Gaiffe recently called the attention of the physical section of the French Academy to a new form of battery invented by him. It consists of a carbon cylinder, pierced with holes parallel to the axis, the holes being filled with binoxide of manganese, for the positive pole; and a zinc rod for the negative pole. The solution is formed of 20 parts of chloride of zinc, free from lead, and as neutral as possible, dissolved in 100 parts of water. The electro-motive force, resistance, and constancy of the cell, are said to be unimpaired by this substitution of zinc chloride for ammonium chloride. Oxide of zinc is formed, and falls in a state of powder on the bottom of the vessel. It is claimed for this cell that it does not produce double chlorides of zinc and of ammonium, which, in certain cells, incrust the porous pots, and stop their action. It is further held that the affinity of chloride of zinc for water checks the evaporation sufficiently to render the drying up of the cell very unlikely.

THE THERMO-ELECTRIC PROPERTIES OF LIQUIDS.—In a recent communication to the Royal Society, Dr. G. Gore, F.R.S., described an improved apparatus for

examining the thermo-electric properties of liquids, by the use of which, with the precautions stated, all sources of error in experiments on this subject appear to be removed. He also described a number of experiments he has made with it, and the results obtained. By employing a sufficient number and variety of electrically-conducting solutions, of acids, salts, and alkalies, in those experiments, he has discovered several exceptions to the usual effect he had formerly obtained, viz., that acid liquids are thermo-electro-positive, and alkaline ones thermo-electro-negative; and has sketched a diagram representing the thermo-electro behaviour of heated platinum in three of the exceptional liquids. Reasoning upon the satisfactory results obtained, he concludes:—1st. That the electric currents are not produced by chemical action; 2nd. Nor by a temporary dissociation of the constituents of the liquids; 3rd. Nor by the action of gases occluded in the metals; 4th. But that they are produced purely and solely by the heat, and that heat disappears in producing them; 5th. That they are immediate or direct effects of the heat, and that aqueous conducting liquids, therefore, possess, true thermo-electric properties; 6th. That the current is a result of a difference of thermic action at the surfaces of the two pieces of metal; 7th. That it is a product of a suitable molecular structure of the liquid, a change of such structure resulting from alteration of temperature, and a direct conversion of heat into electricity; and 8th. That the circumstance which is most influential in enabling heat to produce the currents, and most determines their direction and amount, is a suitable molecular structure of the *liquid*. By means of the apparatus and process described, he has discovered irregular molecular changes in several of the liquids examined; and as molecular changes are the bases of various physical and chemical alterations, he suggests the use of this apparatus and method as a new one for discovering anomalous molecular alterations, and other co-incident physical and chemical ones, in electrically conducting liquids; and for detecting differences of electric potential between metals and liquids at different temperatures. Dr. Gore also concludes as probable, that when a piece of metal is simply immersed in a suitable liquid, a change of temperature occurs; and this (if correct) is a parallel fact to that of the production of electricity by simple contact only. The results also support the contact theory of voltaic electricity. The paper concludes with several suggestions of new lines of research suggested by the experiments, one of which is the construction of a new thermo-electro-motor. Since writing his paper, Dr. Gore has proved by experiment, that when a sheet of platinum is immersed in various saline, alkaline, and acid liquids, a slight rise of temperature takes place.

THE Electric Writing Company, of King William Street, are trying to introduce the Edison Electric Pen for writing the sums on cheques and notes indelibly by fine perforations and without ink.

A NEW Telegraph Apparatus, capable of transmitting and receiving a hundred and twenty, and under certain conditions even two hundred and fifty messages per hour, is reported from Vienna. It is the invention of Herr A. Eduard Granfeld, an Austrian telegraph official, and the experiments are said to be completely successful.

AN ELECTRIC ZOOPHYTE.—A correspondent writes to a contemporary pointing out the fact that the ordinary *Zoophytus Plasticus* has a large natural store of electricity which it is capable of discharging into the water after the manner of the electric eel. Shocks have been felt from it by persons bathing. The writer charged a small Leyden jar with the discharge, the electricity being positive. After several experiments the Zoophyte became visibly weaker, and died in a few hours.

A DETERMINATION of Siemens' unit of resistance. The *Philosophical Magazine* for January, February, and March, contains an account of an important determination, by Professor H. F. Weber, of Zürich, of the absolute value of Siemens' mercury unit of resistance, that is, the resistance of a column of pure mercury one metre high and one square millimetre in section. His results were obtained by three different methods, namely:—(1) from the variable currents generated by magneto-electric induction; (2) from the variable currents generated by sudden voltaic induction; (3) from the heat developed by steady voltaic currents. The ratios of Siemens' unit to the ohm or British Association unit, thus determined, were respectively 0·9545, 0·9554, 0·9550 to 1. The mean value of these is 0·9550, that is to say, one Siemens' unit = 0·9550 ohms. This result is only $\frac{1}{4}$ per cent. higher than that obtained by the British Association Committee of 1864, which was composed of Professors Clerk Maxwell, Jenkin, and Balfour Stewart. The ratio as educed by them, and entered in our text books and telegraph manuals is 0·9536 to 1. In 1870, a determination by Professor F. Kohlrausch, made the ratio 0·9717 to 1; but this value was not accepted, at least in England. These experiments of Professor Weber may be held as confirming the value assigned to the ohm by the British Association.

A CONSTANT BICHROMATE CELL.—In the *Philosophical Magazine* for March, Mr. H. C. Russell, of Sydney Observatory, describes a form of bichromate cell which he states to be perfectly constant in its action. It consists of a bichromate cell with the zinc plate standing in mercury, and the peculiar feature is that fresh bichromate solution is constantly fed into the top of the cell, drop by drop, while the waste solution is drawn off from the bottom, drop by drop. This is effected by a syphon arrangement which draws off the waste liquor from the bottom, drop by drop, as the level of the liquid in the cell is raised by the indropping solution: thus a constant level is maintained.

IN continuing his experiments on the reflection of a beam of polarised light from the surface of a magnet, Dr. Ker, of Glasgow, has obtained feebler but similar effects by reflection from the equatorial surface of the magnet as from the polar surface. The experiments only yielded perceptible results at angles varying from 85° to 30°. The law of the magneto-optical action involved in these experiments may be stated as follows:—Whatever the angle of incidence between grazing and normal, the effect of magnetising the mirror is to turn the plane of polarisation of the reflected light through a very small angle, in a direction always contrary to that of the hypothetical currents of Ampere supposed to cause the magnetism. When the plane of incidence of the polarised ray was perpendicular instead of parallel to the lines of magnetic force, no optical effect of magnetisation could be perceived.

LORD ODO RUSSELL has conferred with the Postmaster-General Stephan of Germany, concerning the postponement of the Telegraphic Congress to June 1879.

THE *Standard* hears that the Government are about to extend the means of telegraphic communication in the Mediterranean.

IN *Cassell's Family Magazine* for May is to be found a paper descriptive of a supposed "Conversazione of Telegraph Engineers." Under the light veil which the writer has thrown over them we recognise one or two well-known professional figures.

A TELEGRAPH TO LUNDY ISLAND.—On Thursday, April 19th, at a meeting of the Cardiff Shipowners' Association (at which Swansea and Newport were also represented), it was resolved to form a company to connect Lundy Island (from the south-east corner) by telegraph with the mainland at Hartland, and thence with the Government wires. It was estimated that the expense of laying the cable, erecting a signal station, &c., would be £5,500. The working expenses were put down at £300 a year, and it is anticipated that the company can be worked at a profit. The capital of the company will consist of £10,000 in 1,000 shares, and two-thirds of the capital will be called up. About 160 shares were taken up in the room, and a working committee of representative gentlemen at Cardiff, Swansea, Bristol, Newport, and Gloucester was formed. —*Engineering.*

THE Scilly Islands line having been purchased by the Post Office, and the cable connecting Scilly with the main having been repaired, messages between Scilly and other parts of the United Kingdom are now forwarded by telegraph to their destination there at at the ordinary inland rate.

EDISON'S TELEPHONE.—On April 2nd, a successful trial of Edison's carbon telephone was made between New York and Philadelphia, over one of the many lines of the Western Union Company traversing this distance. The line in question was 105 miles long, and ran for most of the way beside other wires passing underground in New York to the W. U. office. The induction disturbances from the working of the neighbouring lines were considered sufficient to obliterate the articulation of any other telephone but Edison's. Two cells and a small induction coil were used to operate it. A number of gentlemen, including the late President Orton of the W. U. Company, Mr. Edison, Mr. Phelps, and Mr. Batchelor, who is Mr. Edison's chief assistant. Edison, in New York, conversed freely with Mr. Batchelor and Mr. Phelps in Philadelphia. Phelp's magneto telephone, which is, perhaps, the most powerful of its class, was also tried; but although words and occasional sentences were transmitted, it did not give the satisfactory results given by Edison's.

Patents.

1326. "Improvements in interlocking apparatus for the points and signals, and telegraphic block instruments of railways."—C. HODGSON, April 4.

1370. "Telephones."—A. PARIS, April 6.

1419. "Apparatus for transmitting messages."—M. T. NEALE, April 9.

1467. "Method of originating and developing electric currents."—N. C. SPALDING, April 12.

1519. "An apparatus for raising ships, anchors, chains, telegraph cables, and other property sunken in the sea, or rivers, or lakes."—N. SCHALLEHN, April 16.

1522. "Elements or parts of galvanic batteries."—P. GRABINGER, April 16.

1564. "Improvements in apparatus for igniting and extinguishing gas by electricity; parts of which improvements are applicable in the employment of electricity for other purposes."—W. R. LAKE (communicated by J. W. Bartlett), April 18.

1587. "Improvements connected with means or apparatus for the production, application, and regulation of electric currents."—J. L. PULVERMACHER, April 20.

1613. "Improvements in transmitting and receiving telegraphic messages or signals, specially applicable to field telegraphy, and in apparatus for the purpose."—J. B. G. MANGENOT, April 22.

ABSTRACT OF PUBLISHED SPECIFICATIONS.

2538. "Electric telegraphs."—J. and A. MUIRHEAD, July 2nd, 1877. 10d. This relates to Muirhead's artificial cable (Patent No. 3653 of 1874) and various devices for employing it in duplex working on submarine cables. It consists in employing lengths of the inductive resistance or artificial cable in place of the differential resistances employed in duplex systems of working. Also in effecting a balance without the need of a full artificial or compensating circuit, and thereby saving apparatus, by connecting the receiving instrument with some part of the compensating circuit which will obviate any "kicks" or momentary currents on it due to sending.

2696. "Telegraph apparatus."—LAURENTIUS CARLANDER, Stockholm, July 12, 1877. 2d. This consists of an automatic transmitter and puncher for the paper. *(Not proceeded with.)*

2880. "Telegraphic apparatus."—HENRY GARDNER, July 27, 1877. 6d. This consists of a semi-automatic

signalling key, whereby the sender has not to consider the relative duration of dots and dashes. Two contiguous keys, one for dots and dashes, are employed. These keys are connected by two vertical rods to a double-branched interruptor lever, the lowering of which determines the contact which closes the circuit. The ends of the two branches upon which the rods of the key act are furnished with distinct appendages so combined that the oscillation of the interruptor lever is effected differently, according as it is desired to produce a short or a long contact. *(Not proceeded with.)*

2889. "Electro-magnetic apparatus."—J. N. H. BOUCHER, Paris, July 28, 1877. 2d. This consists of electro-magnetic jewellery and articles of attire designed for the remedy of certain diseases. These are termed the "Volta-Boucher" apparatus for winter and summer. Ear pendants of different metals, with a tail or end piece to be introduced into the ear; rings composed with a view to act more or less energetically, and placed one, two, or three on each hand, but of necessity alternately, for example, one on the thumb, the second on the middle finger, the third on the little finger, so that the fore-finger and fourth finger serve as separators; spectacles having the frame made of different metals; bonnets or head-dresses; belts, garters, and a "dalmatic" dress of Boucher fabric are the specialties described by this invention. The latter is an electro-magnetic shirt provided with a galvanic chain at the upper part, a mouth-piece to be inserted in the mouth, another to be fixed in the anus; and if the dress only extends to the thighs a chain may be employed for the legs with a ring at the end to be secured to the big toe. *(Not proceeded with.)*

2892. "Stopping runaway horses."—PIERRE RONDEL, Paris, July 28, 1877. 2d. This consists in administering a shock to runaway horses to compel them to stop. A Ruhmkorff coil, or electrical machine, under the driver's control generates the shock which travels by wires along the reins, and is passed through the nostrils of the horse. *(Not proceeded with.)*

2909. "Controlling by sound the transmission of electric currents, and the reproduction of corresponding sounds at a distance."—T. A. EDISON, New Jersey, U.S. This describes Edison's well-known telephonic apparatus with the transmitter based on the varying resistance of plumbago under pressure, and the receiver based on the alteration in the friction of certain surfaces by the passage of an electric wave between them.

2934. "Electric lamps."—SIEGFRIED MARCUS and BELA EGGER, Paris, July 31, 1877. 8d. This relates to a regulator for the electric light. The carbon points are so supported through the medium of a pulley that they move together or apart simultaneously. They are counterpoised or balanced round this pulley so that a slight rotation of the pulley in one direction or the reverse approaches or recedes both the carbon points simultaneously. This regulating motion is obtained from the current through an electro-magnet with a moveable core in its centre. This moveable core is suspended from one of the carbon points, that is to say, from the pulley, and acts as a counterpoise to the other carbon point also supported by the pulley. When the arc between the points is of proper length this suspended core takes up a certain position in the electro-magnet; but when the arc is too short or too long the current is too strong or too weak, and the core is pulled down or let up within the electro-magnet and this movement rotates the pulley until the points are adjusted to their proper relative positions.

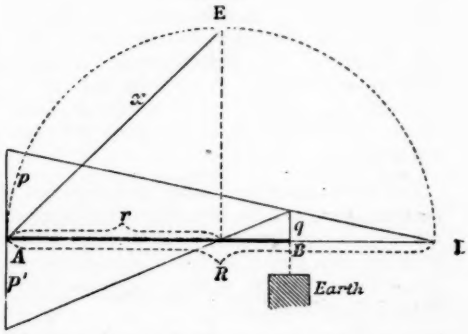
2927. "Instruments for transmitting telegraph messages."—THOMAS ALVA EDISON, New Jersey, U.S. Dated July, 31. 2d. This consists of a means of recording messages, so that the message may be used to transmit upon another circuit. The record is made by indentations along a volute line on a disc grooved to correspond, or along a zig-zag groove on a cylinder. The paper is put upon the disc or cylinder in a predetermined position, regulated by register marks, so as to be held accurately in place, and the indenting point is upon an arm or slide kept in position by a corresponding groove, or volute, or otherwise, so that the indenting point is always over the groove, and will indent the paper down into the groove when the point is pressed upon the paper. The point is operated by an electro-magnet. The idented record of the message obtained on the paper is used automatically to transmit the message afterwards on another line.

Correspondence.

To the Editor of THE TELEGRAPHIC JOURNAL.

DEAR SIR,—In your issue of November 15th, 1877, you published a formula by Mr. Ch. Dresing, "for calculating the copper-resistance during electric disturbances (earth currents)", and in the number of the TELEGRAPHIC JOURNAL for December 1st, Mr. Dresing writes again regarding the simplicity of this new formula. To these two articles Professor Ayrton has drawn my attention, remarking that in obtaining the formula, Mr. Dresing appeared not only to have neglected the resistance of the testing battery, but also to have assumed that the resistance of one or both of the arms of the Wheatstone's bridge was extremely small, and in addition, that in the formula the unknown resistance, as given by the geometric mean of the observed values, could only be true in the few cases when it was also equal to their arithmetic mean. I have, therefore, examined the question, and, for the benefit of students like myself, beg to forward my conclusions so that, should I have misunderstood Mr. Dresing's communications, he will do me the favour to correct my false impression.

Fig. 1.



First, however, I would suggest that the following may be the answer to your query in the December number "How can Mr. Schwendler's formula give too low a result?" The *first* formula for x on page 29, Clark and Sabine's Electrical Tables, is a *mathematically*

correct one, and therefore, as you remark, if properly worked out, it must give the exact value of x. But I think the formula practically used, and the one therefore probably which Mr. Dresing refers to, is not the first complicated (but at the same time complete) one, but the *second* form to which the first reduces itself when we neglect the battery resistance. Now the reason why this second formula gives a result smaller than the truth, is comparatively simple. Since the first formula may be written in the form—

$$x = \frac{b}{a}\left\{\frac{w' + w''}{2} - \frac{(w'' - w')^2}{2(w' + w'') + 4f\left(1 + \frac{a}{b}\right) + 4a}\right\},$$

where w' and w'' are the values obtained when testing with the positive and negative currents, we see that neglecting f, the battery resistance, increases the value of the second term, and therefore diminishes the value of the whole expression. Consequently the second formula for the value of x, the one in which the battery resistance is neglected, gives an answer always *smaller* than the truth.

With respect to the diagram given by Mr. Dresing, fig. 1 in this letter, how does he know that A E represents x, the true wire resistance of the line? Does not A B represent x as A C* and A D represent r and R respectively? It is clear that A E is the geometric mean of r and R, but why it represents x is not evident. Further, it may easily be shown that A B equals $\frac{2Rr}{R+r}$, for

$$\frac{p}{R} = \frac{q}{R - AB},$$

and

$$\frac{p'}{r} = \frac{q}{AB - r},$$

therefore, since $p = p'$, we have

$$AB = \frac{2Rr}{R+r},$$

But $\frac{2Rr}{R+r}$ is not equal to $\sqrt{Rr}$ unless R and r are equal to one another, or unless A B equals $\frac{R+r}{2}$; consequently A B cannot equal A E generally.

Again, it must be remembered that Mr. Dresing's figure only represents the potential curve in a small portion of the bridge, the complete curve being shown in fig. 3 of this letter, S A representing b in fig. 2, A B standing for x, A C and A D the apparent values obtained when testing with the positive and negative currents. Now, if the resistance of the battery be small, P and P' in fig. 3 will be equal, but not p and p', which are the same as p and p' in figure 1. And the only case in which p and p' will be equal (which Mr. Dresing appears to assume always to be the case) will be when S A, or b in fig. 2, is nought, a condition that would only be fulfilled when a single platinum wire bridge (such as was employed by the British Association Committee) is made use of. But such a bridge is well known to be very unsensitive when measuring large resistances, such as those of telegraph lines.

The correct graphical proof of Mr. Schwendler's formula is given by Mr. F. Jacob in your Journal for October 1st, 1876, where he arrives at the result

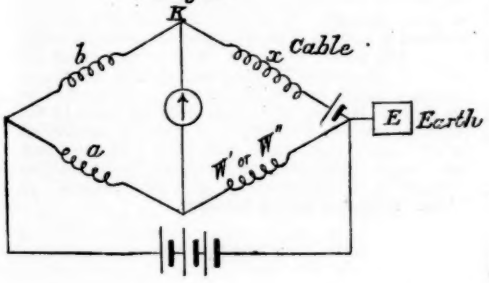
$$x = \frac{b}{a}\left\{\frac{w' + w''}{2} - \frac{(w'' - w')^2}{2(w' + w'' + 2a)}\right\},$$

which is the same as that given by Messrs. Clark and Sabine when the battery resistance is neglected. Now if in this last equation

$b = a =$ a very small quantity,

under which latter hypothesis only is Mr. Dresing's figure correct,

Fig. 2.



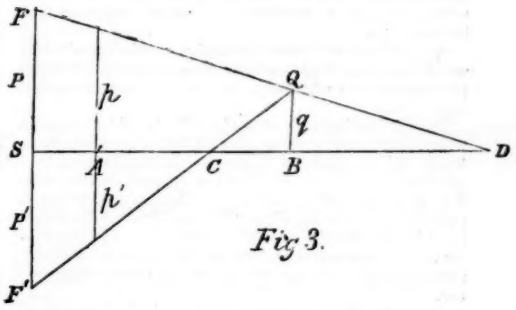


Fig. 3.

$$x = \frac{2w'w''}{w' + w''}$$

which you will observe is the value I obtained above directly from the figure in question. But, as already mentioned, this can only reduce itself to $\sqrt{w'w''}$ either when w' equals w'', or when

$$x = \frac{w' + w''}{2}$$

It therefore seems as if Mr. Dresing's geometrical mean formula, which he proposes to use in all cases when there are strong natural currents in the line, can be used—first, only when the natural current is very weak; secondly, only when the resistance of both branches of the Wheatstone's bridge is very small.

I have the honour to remain

Your obedient servant,

J. FUJIOKA,

Student of Telegraph Engineering.

The Physical Laboratory,

The Imperial College of Engineering,

Tokio, Japan. February, 1878.

* C has been accidentally omitted in the Fig., it should be the centre of the circle.—EDIT. TEL. JOUR.

L. V. F.—Duly received with thanks.

Proceedings of Societies.

SOCIETY OF TELEGRAPH ENGINEERS.

(Continued from page 171.)

In France, a few years ago, an insulator of a very inferior character was employed. Since then, however, the French have assimilated their systems to those of other European countries, having adopted a form of double-cup insulator for all important circuits, and one with a single cup for less important lines, viz., for lines varying from 50 to 200 kilomètres in length.

In Spain, Siemens' insulators were, until recently, almost wholly employed, but now the Prussian pattern, slightly modified, so that a groove in the top of the insulator supports the wire, is used. The groove is necessary, because in that country the old system of winders is still in existence. Insulators of the Prussian form, fitted on the upper extremities with two winding drums, are placed at intervals of one kilomètre apart, the line wire running loosely through the grooves in the intermediate insulators.

In America, glass, as has already been mentioned, is almost wholly employed. The form mostly adopted consists of a single glass cup, in shape somewhat similar to the outer cup of a Varley's insulator. The interior of the cup is fitted with a female screw, into which is fixed a wooden pin, which supports the insulator.

An insulator called the Kenosha, consisting of white wood saturated with an insulating compound, the top protected with a metal cup, has likewise been somewhat largely used.

Brook's insulator consists of a cylindrical iron case, in which is inserted a blown glass bottle of peculiar form. Inside this is fastened a pin, which, terminating in a species of double hook, forms a support for the wire. It is claimed that a surface of blown glass, which is cooled by air contact alone, offers particular advantages in resisting deposits of moisture and dirt. This insulator has given some very good results, but it has not been practically tried in Europe against the forms in general use.

Testing.—The following is the method of testing at the chief factory of the Post Office in London.

All insulators are deposited in tanks, and filled with water, both inside and out, to within three-quarters of an inch to the lips. To prevent surface leakage, which would always exist in damp weather, they are kept dry on the edges by the heat of numerous jets of lighted gas, placed just above them, or the same result may be obtained by keeping the atmosphere of the testing-room artificially dry by means of hot-water pipes. After soaking for twelve hours, they are tested by means of a Thomson's galvanometer and 140 Daniell's cells. An ingenious combination of three keys and shunts is employed. In the normal position the galvanometer is short circuited. On depressing No. 1 key $\frac{9999}{10000}$ of the current is shunted from the instrument. No. 2 key introduces a shunt of $\frac{99}{100}$, and No. 3 gives the full current. If a deflection be given with No. 1 key, the insulator is at once rejected, unless the lips are observed to be wet. If the latter be the case, or if deflections be given on depressing keys No. 2 or 3, the insulator is marked, and subsequently dried and carefully re-tested. Should any leakage still be shown, it is then finally rejected. By this means all defects of manufacture or accidental flaws, are inevitably detected before the materials are passed into actual employment.

In France a somewhat similar system is adopted, the standard being 7,000 megohms.

A series of experiments had been carried out by Mr. Gavey in which the insulation of various sections of line had been compared with the hygrometrical condition of the atmosphere, and from which it appeared,

First, that there is as it were a great wave of moisture that sweeps daily over the land, having its maximum near midnight, and its minimum at noon; and that accordingly the insulation of our circuits, generally low from 7 to 9 a.m., rises to a maximum from 11 a.m. to 3 p.m., then abruptly falls, reaching a minimum between 7 p.m. and midnight.

Secondly, that very frequently the most abrupt changes in insulation take place in a most limited time; the resistance dropping from several megohms to a fraction of a megohm per mile in the course of an hour or two.

Thirdly, that the resemblance between the insulation and moisture curves is very remarkable; so much so, in fact, that it is not improbable that an extended series of insulation readings would form a more accurate register of moisture over any given extent of country than ordinary hygrometrical readings.

Further experiments had been made in which the various forms of insulators were compared among themselves. The subjoined table gives the result of these trials.

When considering the advantages of any description of insulator, it is evident that one may have a better form for insulation under all circumstances than another of an inferior shape, but it may give an equal or lesser absolute resistance, owing to the latter having a greater length, or lesser section than the former. It therefore becomes desirable to reduce the absolute results, obtained in a series of tests for such as those recorded, to an unit result, so that a clear conception of the value of form may be obtained, and, if necessary, increased length or diminished section be applied to get the best results. This is done in the table in the following manner. The lengths of each cup are divided by the mean circumference, both inner and outer, and the absolute resistances are multiplied by the fraction —length by circumference—to give the "reduced" or "form" resistance of each insulator.

TABLE.

AVERAGE OF 23 TESTS OF 10 INSULATORS OF EACH DESCRIPTION.

Description.	Average Resistance, absolute.	Order of Merit.	Reduced Resistance.	Order of Merit.
Porcelain D.S. P.O. large New..	13374·8	1	9302·9	1
Johnson's and Phillips' No. 5 ..	5428·6	2	5428·6	2
Johnson's and Phillips' Iron-capped	1346·6	3	1346·6	3
Porcelain D.S. Iron-capped ..	166·088	4	137·603	4
Porcelain D.S. Andrew's Old ..	56·004	5	41·36	5
Porcelain D.S. P.O Terminal ..	52·71	6	39·381	6
Porcelain D.S. Fuller's and Langdon's	45·426	7	25·363	11
Porcelain D.S. P.O. Form ..	41·988	8	29·32	8
Porcelain D.S. Prussian Form ..	41·651	9	26·14	10
Porcelain D.S. Andrew's New ..	41·214	10	36·802	7
Earthenware D.S. Varley's ..	32·040	11	28·9	9
Porcelain D.S. Fuller's Cone ..	31·08	12	17·695	13
Earthenware S.S. P.O. Form ..	31·059	13	17·341	14
Porcelain D.S. Corrugated ..	25·524	14	15·70	15
Porcelain D.S. Indian Form ..	25·376	15	12·919	19
Porcelain D.S. P.O. Form ..	20·284	16	14·168	16
Porcelain D.S. Schomburg's Short	19·089	17	23·62	12
Porcelain D.S. Schomburg's Varley's Form	13·039	18	9·90	18
Porcelain S.S. Schomburg's Varley's Form	12·013	19	13·757	17
Porcelain D.S. Terminal.. ..	0·912	20	10·643	20
Porcelain S.S. P.O. Form ..	13·880	21	5·82	21

PHYSICAL SOCIETY.—APRIL 13th, 1878.

Prof. A. B. CLIFTON, Vice-President, in the chair.

The following candidates were elected members of the Society:—W. Campbell, R. W. F. Harrison, Rev. S. N. Hutchinson, M.A., B. W. Richardson, M.B., F.R.S.

The SECRETARY read a paper by Messrs. J. Nixon and A. W. Heaviside, describing their experiments on the mechanical transmission of speech through wires or other substances, to which Mr. Preece had referred at a previous meeting of the Society. After describing a number of experiments in which metallic discs soldered on to the ends of the conducting wires were employed, they went on to enumerate the more successful experiments in which wooden discs were mainly employed. The first actual transmission of speech was effected by placing the belly of a violin against the receiving end of the wire, when every syllable spoken was distinctly audible. Very good results were obtained by employing mouth and ear pieces, formed as in a telephone, the disc being replaced by thin wooden discs six inches in diameter, and a No. 4 wire was found to be most satisfactory. On suspending a length of this wire in such a manner that it had no rigid attachments, it was ascertained that 120 yards is the limit through which a conversation can be carried on.

Captain ABNEY, F.R.S., described the method he adopted for photographing the least refrangible end of the spectrum. He pointed out that it is impossible, with the ordinary sensitive salts employed in the usual way, to photograph further than the Fraunhofer line E; though, by a preliminary exposure to light of a Daguerreotype plate, Draper is able to photograph beyond the extreme limit of visibility in the red end of the spectrum. This method, however, gave what is known as a reversed picture, the lights and shades being transposed, besides requiring a lengthened exposure. It enabled Becquerel to photograph the spectrum in its natural colours; and, later, St. Victor obtained coloured images of coloured cloths. The object of Captain Abney had been to obtain unreversed pictures of this portion of the spectrum, in other words, to obtain a compound that would be similarly sensitive to the red and the blue components of white light. Such a compound he had at last obtained by what he termed *weighting* silver bromide with resin, and now he obtains it by causing the molecules of silver bromide to weight themselves. He showed an ordinary bromide of silver plate, and the colour of the transmitted light was of a ruddy tint, showing absorption of the blue rays. Another film was shown containing weighted bromide of silver, which transmitted blue light and absorbed the red. Photographic plates prepared with the latter compound he showed were sensitive to the red and ultra-red waves of light; and he threw on the screen photographs of the spectrum from the line C to a wave length of 10,000, the ultra-red showing remarkable groupings of lines. He further showed that by friction the blue film was changed to the red, and in that state was not sensitive to the lower part of the spectrum. These photographs were taken by means of a diffraction grating, and Captain Abney demonstrated Fraunhofer's method of separating the various orders of spectre produced by it. He then explained that recently he had elucidated the reason of the reversal of Draper's pictures by the least refrangible end of the spectrum. He finds that it is accelerated by exposing the plates in weak oxidizing solutions, such as those of hydroxyl, bichromate of potash, permanganate of potash, and nitric acid, or exposure to ozone. The red rays, in other words, seemed to oxidize the photographic image, and to render it incapable of development.

Mr. H. BANERMAN then exhibited some paper models, illustrative of the disposition of the planes of symmetry in crystals. These included octants of the sphere with enclosed cube and octahedron faces pointed into their corresponding hexakis-octohedral faces; a cubic skeleton built up from nine planes of symmetry with a removable outer shell, and a system of axial planes of an unsymmetrical mineral enclosing a solid nucleus contained between three parallel pairs of planes. They were constructed for the purpose of showing popularly the difference between planes of symmetry and other diametral planes by laying upon them a small mirror or plate of mica, when, in the first case, the nucleus gave a symmetrical image corresponding in position to the plane immediately behind the mirror, but in the second a broken image is produced.

Dr. GUTHRIE exhibited the arrangement of apparatus he had employed in conjunction with his brother, to ascertain the effect of heat on the transpiration of gases. The main difficulty connected with the research was the securing of an absolutely constant pressure on the air operated upon. This was secured by inserting into the neck of the vessel, which served as an air-chamber, a tube turned up at its inner end, and terminating externally by a small funnel. As the tube was kept constantly full of water, the funnel overflowing, a pressure, represented by the difference between the heights of these levels, was maintained. After passing through a series of drying tubes, the air traversed the (V-shaped) capillary tube in a beaker containing water of known temperature, and was finally received in an inverted tube contained in an overflowing dish of water. Among other results it was found that the resistance of a tube is the same as that of its several portions; and if t be the time occupied, τ the absolute temperature, p_1, p_2 the pressures, and α & β constants, they find that $t = \alpha\tau\left(\frac{\tau+\beta}{p_1-p_2}\right)$

THE INSTITUTION OF CIVIL ENGINEERS.

AT the meeting on Tuesday, the 9th of April, Mr. Bateman, President, in the chair, the Paper was on "The Embankments of the River Thames," by Mr. Edward Bazalgette, Assoc. Inst. C.E.

The first Commissioners for embanking the Thames were appointed in 1367. Acts for constructing embankments and improving the navigation were passed in the reigns of Henry VIII. and of Elizabeth. Sir Christopher Wren proposed an embankment from the Temple to the Tower, after the fire of 1666. Sir Frederick Trench and Mr. Martin suggested similar embankments. In 1840 Mr. James Walker laid down a line for a northern embankment for the Corporation of London, to be raised 4 feet above Trinity High Water. His line and levels had since been adopted. Various Parliamentary Commissions and Committees had considered the subject. In 1862, an Act was obtained by the Metropolitan Board of Works for the formation of the Victoria Embankment, from Westminster to Blackfriars Bridge. In 1863, another Act was passed for the construction of the Albert Embankment, from Westminster to Vauxhall Bridge. And, lastly, in 1868, the Act for the Chelsea Embankment, from Chelsea Hospital to Battersea Bridge, was sanctioned. These embankments comprised about 3½ miles of river wall, and had reclaimed 52 acres of land.

The Victoria Embankment, about ¾ mile long, cost £1,200,000, besides £450,000 paid for the purchase of property. The foundations of the retaining wall of the embankment were put in behind cofferdams, made in some places of timber and in others of oval wrought iron caissons.

The bottom portions of the iron caisson cofferdams

were filled with concrete, and left in the ground permanently, and the piles of the wooden cofferdams were cut off under water at various levels, in both cases to protect the toe of the wall. The upper portions of the caissons were in half rings, and were capable of being used several times. Both the iron and timber cofferdams were supported by timber shoring from the land side. The caissons were sunk by weighting them, and excavating within them by three methods: 1, by men working inside, the water being kept down by pumping; 2, by men working within, the water being excluded by pneumatic pressure; and 3, by a telescopic dredger, the water being allowed to rise and fall within the cylinders. By the first plan 6 cubic yards, by the second 5·31 cubic yards, and by the third 10 cubic yards of material were excavated per diem. Again, according to the first system, a cylinder was sunk on an average in eight days and a-third, and the labour cost 14s. 6d. per cubic yard. By the second, a cylinder was sunk 20 feet in eleven days and a-half, and the labour cost 12s. per cubic yard. By the third, a cylinder was sunk in less time at a cost of 8s. per cubic yard for labour.

The foundations rested on clay, and were made of Portland cement concrete, on which the retaining wall was built of brickwork faced with granite. A sewer and a subway for gas and water pipes was formed in the retaining wall; and the Metropolitan Railway was constructed under the roadway along the whole length of the embankment. The Albert Embankment cost £309,000, and was about 4,300 feet long. Timber alone was used for the cofferdams in constructing this embankment, and the retaining walls were partly made of concrete, instead of brickwork, with a facing of granite. Opposite Millbank the river was widened from 600 to 720 feet for a length of 600 feet. The Chelsea Embankment, commenced in July, 1871, and completed in May, 1874, was over ¾ mile in length. The embankment wall was composed of concrete, faced with granite; a sewer for carrying the sewage from Hammersmith was constructed behind it. The cost of the works was £134,000.

In the discussion which followed the reading of the paper, and which occupied the whole of the time at the meeting on Tuesday, the 16th April, and in which Mr. Abernethy, Mr. Shelford, Sir J. Bazalgette, Mr. Redman, Mr. Shield, Mr. Giles, Mr. Latham, Mr. Law, and Mr. Scott-Russell, took part; the causes of the increased rise of tide, which has occurred of late years above London Bridge, were mainly dwelt upon. It was considered by most of the speakers that the embankments had little or no effect upon the tide, but that the observed rise was almost entirely due to the removal of old bridges, and the improvement of the channel both above and below London Bridge by dredging, whereby a larger volume of tidal water was admitted up the river, and also to the extension of arterial and subsoil drainage, which brought the flood waters down more rapidly and in greater volumes within a given time. It was admitted that experience showed that five feet, instead of four feet, should be adopted for the height of the embankments above Trinity high water mark. Mr. Abernethy considered that in cofferdams simplicity of construction and rapidity of execution were the main objects, and that in both these respects timber cofferdams were preferable to iron caissons. Sir. J. Bazalgette explained that the iron caissons had been used where the foundations had to be carried to the greatest depth, and that by using them they had been enabled to place the foundations at a higher level than would have been safe with a timber dam. He mentioned that the failure which had occurred along a short length of the Chelsea Embankment, was due to the removal, by the Thames Conservancy, of a portion of the pilework foundations of an old pier which stood in front of it. There was a general concurrence of opinion expressed that the Thames Embankments were amongst the finest works adorning the metropolis, and that such works, designed solely with a view to the public good, could only be carried out by a public body by means of public funds.

THE METEOROLOGICAL SOCIETY.

THE usual monthly meeting of this society was held on Wednesday, the 17th instant, at the Institution of Civil Engineers, 25, Great George Street, Mr. C. Greaves, President, in the chair. Mons. Marié Davy, Capt. N. Hoffmeyer, Prof. D. Ragona, and Dr. A. Wojeikoff were elected honorary members. The discussion on "Waterspouts and Globular Lightning," which was adjourned from the last meeting, was resumed and concluded. The following papers were then read:—

"On the application of Harmonic Analysis to the reduction of Meteorological Observations, and on the general methods of Meteorology," by the Hon. R. Abercromby, F.M.S. The meaning of harmonic analysis is first shown, in reference to average barometric pressure, by tracing the geometrical and physical significance of every step from the barogram till the tabulated results are combined in an harmonic series. It is then shown that, whether we regard this series simply as an algebraic embodiment of a fact, or as a series of harmonic components, as suggested by Sir W. Thomson, it is simply a method of averages, and our estimate of its value must depend upon an estimate of the use of averages at all in meteorology. It is then pointed out where averages are useful, and their failure to make meteorology an exact science is traced to three causes. (1.) That the process of averaging eliminates the variable effects of cyclones and anticyclones, on which all weather from day to day depends; and on this are based some general remarks on the use of synoptic charts, not only in explaining and forecasting weather, but in attacking such problems as the influence of changes of the distribution of land and water on climate, and the cyclic recurrence of rain or cold. (2.) That deductions from averages only give the facts, and not the causes, of any periodic phenomena. The position of diurnal and other periodic variations in the general scheme of meteorology is then pointed out, and it is shown that their causes can only be discovered by careful study of meteorograms from day to day. (3.) That in taking averages, phenomena are often classed as identical, which have really only one common property. For instance, rain in this country is associated with at least three different conditions of atmospheric disturbance, and it is necessary to discriminate between these kinds before meteorology can be an exact science.

"On some peculiarities in the Migration of Birds in the Autumn and Winter of 1877-78," by J. Cordeaux. Mr. Symons gave a verbal description of the recent heavy fall of rain on April 10th and 11th, the greatest amount known to have been registered, being 46. inches at Haverstock Hill.

General Science Columns.

GANGES CANAL HEAD WORKS.

AT the point where the Ganges Canal takes its supply from the Ganges, that river has five channels, two of which are closed, thus forcing the stream to run in the three remaining channels. The bands constructed to direct the river to the canal head are made, some of boulders, and some of cribs filled with boulders. All

these bands are carried away every rainy season, and have to be reconstructed during September and October. Of late years, the increase of canal irrigation made the demand for water so great and so constant that it was determined to build a permanent bar across the entire river at the general level of the cold weather bed. This plan had been tried with success on two of the river channels. At this time the deep channel and main force of the river were on its left bank, and it was the unanimous opinion of the canal engineers that the river should be kept as much as possible on the right bank, and it was accordingly determined to commence the construction of the bar from the left bank, in hopes of driving the river towards the right. A length of 300 feet was built in 1864, and had the expected result. In 1874 the length of the bar had been increased to 590 feet; after the rains this length was found to be shingled up, and the force of the river passed beyond its right flank. In 1876 a further length of 290 feet was added, making the total length of the bar, from its left flank, 880 feet. It now became evident that the limit to such extensions of the bar from the left only had been reached, for the river was thrown with so much force on to the right bank that the destruction of the island between two of its channels was threatened, and it was therefore determined that, before next rains, the bar must be completed across the Ganges, and the nose of the island threatened be made strong enough to resist the full force of the river. This has now been done, and although last year's floods were so slight that the work cannot be said to have undergone the test of an average rainy season, from what was seen, full confidence is expressed that it will prove quite successful.

SCANDINAVIAN RAILWAYS.

THERE are throughout Scandinavia 49 lines of railway in operation, having an aggregate length of 5,651 kilometres. Of these, 41 lines are in Sweden, with a total length of 3,907 kilometres; in Norway there are six lines, 587 kilometres in length; and in Denmark two lines, with a united length of 1,157 kilometres. The capital employed in the construction of the Swedish lines has been 402,157,919 francs. During the year 1876 the traffic carried consisted of 6,880,893 passengers, and 4,503,886 tons of merchandise; the total receipts amounted to 38,714,018 francs, and the expenses to 23,576,092 francs. The Norway lines have cost 57,088,984 francs, and during the year their traffic comprised 1,588,769 passengers, and 893,971 tons of merchandise, realising gross earnings amounting to 5,787,294 francs, whilst the expenditure was 4,358,918 francs. In Denmark the railways have cost 142,198,671 francs; the traffic for 1876 was 5,904,545 passengers, and 871,181 tons of merchandise, yielding 14,487,726 francs gross revenue, with expenses amounting to 9,018,807 francs. Analysing these figures a little further it appears that the cost per kilometre of railway in the three kingdoms has been as follows: Sweden, 102,933 francs; Norway, 97,255 francs; and Denmark, 122,903 francs. The net returns were 15,137,926 francs, 1,428,376 francs, and 6,468,919 francs respectively, yielding returns upon the capital outlay in each case of 3·76, 2·5, and 4·54 per cent.

SEWAGE IN THE THAMES.—At the beginning of the year we referred to the report presented by Captain Calver, in December last, to the Thames Conservancy, as to the polluted state of the Thames, and the deposit of sewage in the neighbourhood of the metropolis. At the last meeting of the Metropolitan Board of Works, a report was presented from Sir J. Bazalgette and Messrs. Law and Chatterton, in reply to Captain Calver's report. The conclusions at which they have arrived are as follows:—

"1. That we have shown that there is no documentary evidence to prove that foul and offensive accretions have recently formed within the channel of the Thames, but, on the contrary, that the condition of the river is gradually improving, more especially as regards the depth of its channel. 2. That a true interpretation of the analyses quoted by Captain Calver proves, as is the fact, that both the water and mud of the Thames have improved greatly in purity since the sewage has been diverted from the metropolis to a point lower down the river. 3. That these same analyses show that there is no resemblance whatever between sewage mud and Thames mud, and therefore, that Thames mud cannot be derived from sewage. 4. That there is no evidence whatever which supports the statement that the sewage works its way up the river, and that such statement is contrary to the fact. 5. That the present muddy condition of the river is caused principally by the unprotected state of its banks, which in many parts are being rapidly washed away, and which are the result of a neglect of the duty which legislation has cast upon the Thames Conservators."

It will be seen that the opinions expressed in this report are diametrically opposite to the conclusions at which Captain Calver arrived; and the blame of the present polluted state of the river is thrown back on the Conservancy. The conflict of evidence brought forward by the two opposing parties is complete; and till some independent evidence is forthcoming, the question at issue must remain undecided.

THE ORDNANCE SURVEY.—We are glad to learn that the whole staff of ordnance surveyors is to be employed in England this year, the field survey of Scotland having been completed last year. The one inch to a mile ordnance maps of England were completed several years ago, but a very small portion of the six inch and twenty-five inch maps have been published; and, useful as the one inch maps are for many purposes, the larger scales are urgently needed by landowners, engineers, and surveyors. We think that much more rapid

progress ought to have been made with the survey; and, in this instance, Irish interests cannot be said to have been neglected, as the whole survey of Ireland has been completed and published in the three scales some years ago, and also a half inch to a mile map of each county. The survey of the eastern counties is to be commenced; the survey of Derbyshire, Staffordshire, Shropshire, and Oxfordshire are to be continued, and progress is expected to be made with the survey of Hertfordshire, Buckinghamshire, Gloucestershire, Monmouthshire, and Cornwall during the year.

PROFESSOR TYNDALL ON SOUND-PRODUCERS (*continued*).—Most, if not all, of our ordinary sound-producers send forth waves which are not of uniform intensity throughout. A trumpet is loudest in the direction of its axis. The same is true of a gun. A bell, with its mouth pointed upwards or downwards, sends forth waves far denser in the horizontal plane passing through the bell than at angular distance of 90° from that plane. The oldest bellhangers must have been aware of the fact that the sides of the bell, and not its mouth, emitted the strongest sound, their practice being determined by this knowledge. Our slabs of gun-cotton also emit waves of different densities in different parts. It has occurred in the experiments at Shoeburyness that when the broad side of a slab was turned towards the suspending wire of a second slab six feet distant, the wire was cut by the explosion, while when the edge of the slab was turned to the wire this never occurred.

Theoretic considerations render it probable that the shape of the exploding mass would affect the constitution of the wave of sound. I did not think large rectangular slabs the most favourable shape, and, accordingly, proposed cutting a large slab into fragments of different sizes, and pitting them against each other. The differences between the sounds were by no means so great as the differences in the quantities of explosive material might lead one to expect. The mean values of eighteen series of observations made on board the "Galatea," at distances varying from 1¾ miles, were as follows:—

Weights.....	4-oz.	6-oz.	9-oz.	12-oz.	7-oz. Rocket.
Value of sound..	3'12	3'34	4'0	4'03	3'35

These charges were cut from a slab of dry gun-cotton about 1¾ inches thick: they were squares and rectangles of the following dimensions:—4 oz., 2 inches by 2 inches; 6 oz., 2 inches by 3 inches; 9 oz., 3 inches by 3 inches; 12 oz., 2 inches by 6 inches.

The numbers under the respective weights express the recorded value of the sounds. They must be simply taken as a ready means of expressing the approximate relative intensity of the sounds as estimated by the ear. When we find a 9 oz. charge marked 4, and a 12 oz. charge marked 4'03, the two sounds may be regarded as practically equal in intensity, thus proving that an addition of 30 per cent. in the larger charges produces no sensible difference in the sound. Were the sounds estimated by some physical means, instead of by the ear, the values of the sounds would not, in my opinion, show a greater advance with the increase of material than that indicated by the foregoing numbers. Subsequent experiments rendered still more certain the effectiveness, as well as the economy, of the smaller charges of gun-cotton.

It is an obvious corollary from the foregoing experiments that on our "nesses" and promontories, where the land is clasped on both sides for a considerable distance by the sea—where, therefore, the sound has to propagate itself rearward as well as forward—the use of the parabolic gun, or of the parabolic reflector might be a disadvantage rather than an advantage. Here gun-cotton, exploded in the open, forms the most appropriate source of sound. This remark is especially applicable to such lightships as are intended to spread the sound all round them as from central foci. As a signal in rock lighthouses, where neither syren, steam-whistle, nor gun could be mounted, and as a handy fleet-signal, which dispenses with the lumber of special signal-guns, the gun-cotton will prove invaluable. But in most of these cases we have the drawback that local damage may be done by the explosion. The lantern of the rock-lighthouse might suffer from concussion near at hand, and though mechanical arrangements might be devised, both in the case of the lighthouse and of the ship's deck, to place the firing-point of the gun-cotton at a safe distance, no such arrangement could compete, a regards simplicity and effectiveness, with the expedient of a *gun-cotton rocket*. Had such a means of signalling existed at the Bishop's Rock Lighthouse the ill-fated Schiller might have been warned of her approach ten, or it may be twenty, miles before she reached the rock which wrecked her. Had the fleet possessed such a signal, instead of the ubiquitous but ineffectual whistle, the *Iron Duke* and *Vanguard* need never have come into collision.

It was the necessity of providing a suitable signal for rock lighthouses, and of clearing obstacles which cast an acoustic shadow, that suggested the idea of the gun-cotton rocket to Sir Richard Collinson, Deputy Master of the Trinity House. That idea was to place a disc or short cylinder of the gun-cotton, which had proved so effectual at low levels, in the head of a rocket, the ascensional force of which should be employed to carry the gun-cotton to an elevation of 1,000 feet or thereabouts, where, by the ignition of a fusee associated with a detonator, the gun-cotton should be fired, sending its sound in all directions vertically and obliquely down upon earth and sea. The first attempt to realize this idea was made on 18th of July, 1876, at the fire-work manufactory of the Messrs. Brock, at Nunhead. Eight rockets were then fired, four being charged with 5 oz. and four with 7½ oz. of gun-cotton. They ascended to a great height, and exploded with a very loud report in the air. On the 27th of July, the rockets were tried at Shoeburyness. The most noteworthy result on this occasion was the hearing of the

rockets at the Mouse Lighthouse, 8½ miles E. by S., and at the Chapman Lighthouse, 8½ miles W. by N.; that is to say, at opposite sides of the firing-point. The performance of the rockets could not, in this case, be referred to the action of a favourable wind. It is worthy of remark that, in the case of the Chapman Lighthouse, land and trees intervened between the firing-point and the place of observation, "This," as General Younghusband justly remarked at the time, "may prove to be a valuable consideration if it should be found necessary to place a signal station in a position whence the sea could not be freely observed." Indeed, the clearing of such obstacles was one of the objects which the inventor of the rocket had in view.

In December, 1876, Mr. Gardiner, the managing director of the Cotton-powder Company, had proposed a trial of his material against the gun-cotton. The density of the cotton he urged was only 1·03. While that of the powder was 1·70. A greater quantity of explosive material being thus compressed into the same volume, Mr. Gardiner contended that a greater sonorous effect must be produced by the powder. A Committee of the Elder Brethren accordingly visited the cotton-powder manufactory, on the banks of the Swale, near Faversham, on the 16th June, 1877. The weights of cotton-powder employed were 2 oz., 8 oz., 1 lb., and 2 lbs., in the form of rockets and of signals fired a few feet above the ground. The experiments were arranged and conducted by Mr. Mackie.

The cotton-powder yielded a very effective report. The rockets in general had a slight advantage over the same quantities of material fired near the ground. The loudness of the sound was by no means proportional to the quantity of the material exploded, 8 oz. yielding very nearly as loud a report as 1 lb. The "aerial echoes," which invariably followed the explosion of the rockets, were loud and long continued, shading off, as in all previous cases, by imperceptible gradations into silence. From subsequent experiments it appeared that the gun-cotton and cotton-powder were practically equal as sound producers.

The performance of the syren was, on the whole, less satisfactory than that of the rocket. The instrument was worked, not by steam of 70 lb. pressure, as at the South Foreland, but by compressed air, beginning with 40 lbs. and ending with 30 lb. pressure. The trumpet was pointed to windward, and in the axis of the instrument the sound was about as effective as that of the 8 oz. rocket. But in a direction at right angles to the axis, and still more in the rear of this direction, the syren fell very sensibly behind even the 2 oz. rocket.

The explosion of substances in the air, after being carried to a considerable elevation by rockets, is a familiar performance. In 1873, moreover, the Board of Trade proposed a light-and-sound rocket as a signal of distress, which proposal was subsequently realised, but in a form too elaborate and expensive for practical use. The idea of the gun-cotton rocket with a view to signalling in fogs is, I believe, wholly due to the Deputy Master of the Trinity House. Thanks to the skilful aid given by the authorities of Woolwich, by Mr. Prentice, and Mr. Brock, that idea is now an accomplished fact; a signal of great power, handiness, and economy, being thus placed at the services of our mariners. Not only may the rocket be applied in association with lighthouses and lightships, but in the Navy also it may be turned to important account. Soon after the loss of the *Vanguard*, I ventured to urge upon an eminent naval officer the desirability of having an organised code of fog-signals for the fleet. He shook his head doubtingly, and referred to the difficulty of finding room for signal-guns. The gun-cotton rocket completely surmounts this difficulty. It is manipulated with ease and rapidity, while its discharges may be so grouped and combined as to give a most important extension to the voice of the admiral in command. It is needless to add that at any point upon our coasts, or upon any other coast, where its establishment might be desirable, a fog-signal station might be extemporised without difficulty.

[*To be continued.*]

IRRUPTION OF MOUNT HECLA.—On February 27th, at 5 p.m., several smart shocks of earthquake were felt at Reykjavik, and on the same evening flames were seen rising from behind the mountains in the direction of Hecla. The Rev. Gudmond Jonsson, who lives close to Hecla, reports that at 4.30 p.m. on that day, slight earthquake shocks could be felt. These gathered force during the next hour; until at 5 p.m. two severe shocks, which caused more alarm than real damage, terminated the disturbance. At 8 p.m. a tremendous irruption of flames burst out on the northern side of the volcano, increasing in magnitude till they appeared like gigantic columns, twice the height of the mountain. When the mail left Iceland, on March 22nd, the irruption still continued, but apparently with diminished violence.

City Notes.

Old Broad Street, April 20th, 1878.

THE meeting of the West India and Panama Telegraph Company is held a day too late for us to notice in this issue; but the report is an extremely interesting document—we can imagine what a glaring circular will emanate immediately from Tokenhouse Yard. Nor, it must be admitted, will the author be without considerable justification for sounding the trumpet loudly. We gather in the first place that the total receipts of the company for the year amounted to £77,975 against £63,548 the preceding year, and £24,000 represnts a sum of money worth mentioning. In the second place, while the amount to audit of revenue for the last year has been no less than £37,065, the expenses have been

but £20,139, and there, consequently, remains a balance of £16,925. Adding to this a balance of £905, brought forward from last half-year's account, we find a total of £17,830 available for the directors to deal with at their pleasure. The directors propose to deal with it thus:—they will add, very properly, £1,000 to reserve (a larger sum would have been better, but we must hope for better things this time next year); then they devote £10,369 to the payment of 6 per cent. dividend on the first Preference Shares, and £1,400 to the payment of 6 per cent. dividend on the second Preference issue. Of the remaining sum they will devote £4,416 to the payment of 1 per cent. dividend on Ordinary Shares, and carry forward to the next account £644. Having explained that the half-year from June to December is the least active period of business in the West Indies, the directors direct attention to the circumstance that the receipts from traffic for the half-year show an increase of £4,135, over those of the corresponding period of 1876, due to the augmentive traffic, and it is likewise declared that this increase would have amounted to about £6,300, but for the diminution of revenue occasioned by the interruption of the Para-Demerara Cable and the consequent loss of North and South American business. The interrupted cable will, it is expected, be in working order shortly. At the conclusion of the report we observe that the affairs of the old company are once more brought into prominence, and, accompanying the ordinary statement of accounts, is a statement of the account of the liquidators—liquidating Act £551, or liquidating and re-constructing £722. The debit side of the half-yearly revenue account is noticeable chiefly for an item of £7,847, costs of repairs to cables, while as to the balance sheet it may be mentioned that to the creditors of the company £8,591 is due. On the other hand, £10,411 is owing to the company from sundry debtors. £124 is a small account for bills payable, and £11,948 a considerable one for bills receivable. It is satisfactory to be assured that the liquidation of the old company is at length practically effected, and though we may not quite endorse the averment that the value of West Indian and Panama shares has been increased in the aggregate by 40 per cent. since the adoption of the re-construction scheme, things are looking up decidedly.

In the report of the Submarine Cables Trust for the year ending April 15, it is stated that the revenue of the Trust has suffered very considerably during the year from the competition which took place between the Anglo-American and the Direct United States Companies; which shows that there is, after all, people in the world who have some reason to rejoice at the amalgamation of the companies; does it not? The revenue of the Trust for the year amounted to £24,750 and the expenses to £1,303, leaving a balance of £23,447. It is notified that of this sum £20,844 has been applied to the payment of the coupons due on the 15th October, 1877, and the 15th of April, 1878, and the balance of £2,603 is carried forward. There is nothing in the report or accounts which calls for special remark.

There is much that is encouraging in the neat little report of the Annual General Meeting of the Great Northern Telegraph Company of Copenhagen. Respecting the state of the cables during 1877, there was one interruption—between Denmark and France; but that cable has since been restored, and nothing detrimental has happened to any of the others. The working of the lines has also been extremely satisfactory. Instead of instruments formerly used, the invention of Mr. Lauritzen—a gentleman belonging to the staff of the company—has been adopted with complete success. Mr. Lauritzen is to be congratulated. As to the traffic years, the directors of the company thought that 1874 was a capital year, but 1877 was better, the revenue of the latter exceeding that of the former by 46,634 francs. The number of telegrams transmitted was 739,146. Nor do we find on turning to the report of the cables in China and Japan, any ground for complaint. The cables have been interrupted but only for 35 days during the year; in 1876 they were interrupted for 50, and in 1875, for 89 days. Every one interested in the progress of the science of telegraphy, will be glad to notice this improvement. It is also gratifying to learn that the repairs have, in all cases, been successfully completed by the company's steamer and staff; and no small degree of credit is due to the company for the perseverance its officers have shown in assisting in the inspection of the land lines in Eastern Russia. Before long we hope the company may be able to make some progress with regard to the land lines in China. The final dividend of 2s. 9d. is now payable at Messrs. Hambro's Bank, Old Broad Street.

A new cable law of very considerable importance has been reported favourably to the American Congress. The bill was prepared by Mr. Monroe, of Ohio, and is intended to deal with the applications which are, as we know, from time to time made to the United States Government for permission to land submarine telegraph cables on the American coast. We have not space to spare for the "auditories, stipulations, and reservations," which Mr. Monroe has incorporated in the bill, but they will probably be keenly criticised here. It is quite clear that our friends on the other side of the Atlantic intend, henceforth, to reap any benefits which it may be possible for them to do in return for any concessions they may grant. Nor can we blame them. A general law for the landing of cables will, we think, be a move in the right direction. The provisions of the measure which is now before Congress do not seem to us to be unfair. We imagine, however, that if Congress accepts the substance of them, the "sole right" of landing on the coast of the United States will then, at any rate, be vested in no particular body of shareholders.

We observe that another American journal, the New York *Operator*, referring to a step recently taken by the Western Union Company, says:—"The Western Union reducing salaries under pretext of grading! You must be mistaken. Did not that company's official organ distinctly say that under a single management the telegraphs of the company could be much more economically conducted, thus leaving a larger margin for profits, and that the salaries of operators would be 'apportioned accordingly'? And did not the company assure its employés that it 'would not forget their honourable and manly conduct' on the occasion of the strike of 1870? Surely, no individual possessed of a spark of honour could take so contemptible a means of reducing the salaries of faithful employés after such promises."

An important extension of the Midland Railway Company which cannot fail to be beneficial alike to the shareholders of that company and to those of the Metropolitan District, will come into operation to-morrow. This new service of trains will be from Child's Hill, on the main Midland line, to Earl's Court on the District, *vid* Acton and Hammersmith, and passengers will be conveyed by the Midland Company's own trains from all parts of their system to stations up to Earl's Court, thus establishing direct communication between the Mansion House and Child's Hill. There are, we understand, to be, if necessary, twenty trains each way per day. We believe that before long the trains of the Brighton and South Coast Company will also run over the District lines.